

Comparison of Postoperative Analgesic Efficacy of Ultrasound Guided Erector Spinae Plane Block versus Thoracolumbar Interfascial Plane Block in Patients Undergoing Lumbar Spine Surgeries: A Randomised Controlled Study

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ABSTRACT

Introduction: Patients undergoing lumbar decompressive spine surgeries for degenerative disc disease will have pre-existing chronic pain. Acute postoperative pain, if not adequately treated, will negatively affect the postoperative recovery and patient satisfaction. Pre-emptive regional anaesthetic blocks form the corner stone of enhanced recovery after surgery, minimising perioperative opioid requirements. Paraspinal blocks such as ThoracoLumbar Interfascial Plane (TLIP) block and Erector Spinae Plane (ESP) block are gaining popularity over traditional multimodal analgesia. **Objectives:** To determine whether duration and quality of postoperative analgesia with TLIP block is better than ESP block for lumbar spine surgeries **Methods:** In this randomised double blind study, 40 patients (20 in each group), were randomly allocated to either group E (40 ml of 0.25% bupivacaine + 8 mg dexamethasone for bilateral ESP block) or group T (40 ml of 0.25% bupivacaine + 8 mg dexamethasone for bilateral TLIP block). Time for first analgesic request (TFA), intra-operative hemodynamics, postoperative pain scores and patient satisfaction were measured. **Results:** TFA was similar between the two groups (442.75 ± 105.75 in Group T vs was 461.5 ± 41.58 in Group E, $p = 0.465$). Mean postoperative pain scores were similar at all time periods except at T1 (1.5 ± 1.43 in Group T vs 2.4 ± 1.05 in Group E, $p = 0.029$). Intra-operative hemodynamics, total rescue analgesic requirement and patient satisfaction scores were also similar between the groups **Conclusion:** TLIP block provides equally effective quality and duration of postoperative analgesia, as compared to ESP block, for lumbar spine surgeries.

Keywords: Acute postoperative pain, Analgesia, Degenerative disc disease, Spine surgery

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INTRODUCTION

Lumbar decompressive spine surgeries with or without spine stabilisation are usually performed for alleviating pain and disability caused by lumbar degenerative disc disease. Since these patients will be suffering from chronic pain pre-operatively, surgery related acute post operative pain, if not adequately treated, reduces postoperative patient satisfaction and negatively affects the post operative recovery. These surgeries are usually done in prone position under general anaesthesia. Pre-emptive regional anaesthetic techniques form the corner stone of multimodal analgesia as they offer Enhanced Recovery After Surgery (ERAS) by minimising peri-operative opioid requirements.

Ultrasound-guided Erector Spinae Plane Block (ESPB) is a novel regional anaesthetic technique where local anaesthetic (LA) injection is performed into the fascial plane situated between the transverse process of the vertebra and the erector spinae muscles^[1]. It is a peri-paravertebral fascial plane

block which blocks the dorsal rami, ventral rami and rami communicantes of various spinal nerves. LA infiltration was observed to have paravertebral spread from injection site to three vertebral levels cranially and four levels caudally. It reduced postoperative opioid requirement compared to systemic analgesics^[2]. Its analgesic efficacy has been compared with epidural block and it has similar efficacy with procedural simplicity and minimal complications compared to epidural block^[1].

A novel regional anaesthetic block targeting the dorsal rami of thoracolumbar nerves as they pass through the paraspinal muscles has been described as Thoracolumbar Interfascial Plane block [TLIP] by William R Hand et al ^[3]. They have reported that TLIP block, when performed at L3 vertebral level, provided an area of analgesia that not only covered the midline from L1 to S1 but also had a predictable spread from right to left posterior axillary lines. A second injection is done superior to the posterior thoracolumbar fascia to ensure subcutaneous

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blockade. Bilateral TLIP block exhibited significant efficacy and safe analgesic profile in patients undergoing lumbar spinal fusion surgeries^[4].

Though both TLIP block and ESP block are acceptable paraspinal fascial plane blocks to provide effective postoperative analgesia for patients undergoing posterior lumbar decompressive spine surgeries, the clinical efficacy and duration of postoperative analgesia between the two blocks have not been compared. Therefore in our study we aimed to compare the efficacy and block characteristics of both the paraspinal fascial plane blocks in patients undergoing lumbar spine surgeries

Objectives: The primary objective was to compare the duration of postoperative analgesia between ESP block and TLIP block in patients undergoing lumbar spine surgeries where as the secondary objectives included comparison of quality of both blocks in terms of total rescue analgesic requirement, postoperative pain scores and patient satisfaction.

METHODS

This research study, which was prospective randomised and double blinded, was conducted at a tertiary care referral hospital between June 2021 to October 2025, after obtaining prior institutional ethical committee approval (No.DMC/KLR/IEC/103/2021-22). A written informed consent was obtained from all the study participants enrolled in the study. Study was registered with Clinical Trials Registry of India (No.CTRI/2021/09/036481). Study participants, observers and data analysts were blinded to the intervention done.

Sample size estimation: On the basis of a pilot study of 10 patients, a total sample size of 40 was calculated, with 20 patients in each group, as the necessary number of participants, to detect a 25% increase in duration of post-operative analgesia, at 80% power with an α error of 0.05.

Patients of either gender aged 18-65 years belonging to ASA Physical status I and II, scheduled for single or two level lumbar spine surgeries and willing to participate were included in the study. Patients with history of diabetes mellitus, previous spine surgery, allergy to local anaesthetics, deranged liver or renal function, coagulation disorders were excluded from the study. Study participants that satisfied the inclusion and exclusion criteria were randomised, using computer generated random number program, in to:

Group E: Bilateral ESP block performed in prone position using 40 ml of 0.25% Bupivacaine and 8 mg Dexamethasone (2 ml). i.e., 21 ml on each side

Group T: Bilateral TLIP block performed in prone position using 40 ml of 0.25% Bupivacaine and 8 mg Dexamethasone (2 ml). i.e., 21 ml on each side

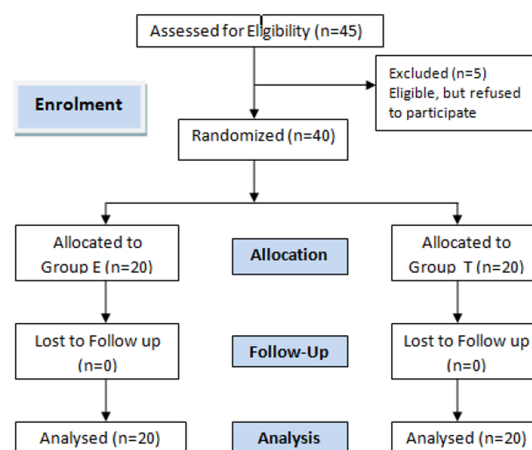


Figure 1: Consort Flow diagram. (Group E- ESP block, Group T- TLIP block)

Patients were educated regarding the pain assessment tool, Numerical Rating Scale (NRS), during their preoperative visit. On the day of surgery, after induction of general anaesthesia and turning the patient prone, anaesthesiologist who was not involved with data collection peri-operatively performed one of the paraspinal fascial plane blocks under ultrasound guidance, as per the group allocation.

Description of ESP Block: Philips Innosight (Philips Ultrasound Inc. USA) linear transducer probe (4-12 MHz) was used to identify the L3 transverse process in parasagittal plane. The erector spinae muscles were identified from outwards to inwards (Fig.2). A 22 G Quincke's spinal needle was inserted using an in-plane superior to inferior approach, so that the tip of the needle lies in the fascial plane on the anterior aspect of the erector spinae muscle. The correct location of the needle tip was confirmed by visible spread of LA mixture between the erector spinae muscles and the transverse process.

Description of TLIP block: Philips Innosight (Philips Ultrasound Inc. USA) Curvilinear transducer probe (2-6 MHz) was used to identify the L3 transverse process in parasagittal plane. In transverse position the plane between Multifidus and Longissimus muscles was identified as depicted in the picture (Fig 3) A 22G Quicke's Spinal needle was inserted in plane, from lateral to medial orientation, at around 30° angle piercing the belly of Longissimus muscle and entering the plane between Multifidus and Longissimus. In this interfascial plane 16 ml of the local anaesthetic mixture was injected and the remaining 5 ml was injected posterior to the posterior thoracolumbar fascia. Similarly the block was repeated on the other side. Parameters observed were duration of surgery, intraoperative hemodynamic variables, total dose of Fentanyl used, time for first rescue analgesic, Postoperative pain (NRS) scores measured at 1, 2,4,6,12 and 24 hours after surgery, total

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consumption of tramadol in 24 hours and patient satisfaction score.

Statistical analysis: Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation. Independent t test was used as test of significance to identify the mean difference between two quantitative variables and qualitative variables respectively.

RESULTS

40 patients were randomly assigned to ESP or TLIP block groups, and all of them completed the study. Both the groups were comparable with respect to age, gender, weight, height, body mass index and duration of surgery. (Table 1).

Table 1: Base line demographic variables and clinical characteristics.

Variable	Group T (n=20)	Group E (n=20)	P value
Age (y)	43.4(16.68)	47.5(12.41)	0.383
Gender [#]			
Male	14(70%)	11(55%)	0.327
Female	6(30%)	9(45%)	
Weight (kg)	66.1(13.07)	67.35(11.04)	0.746
Height (m)	1.67(0.09)	1.67(0.06)	1.000
BMI (Kg/m ²)	23.52(3.69)	24.04(3.67)	0.658
Surgical duration (min)	148.75(38.59)	155.5(33.48)	0.558

Data were expressed as mean (standard deviation) or percentages. Group T=TLIP block, Group E= ESP block, BMI= Body mass index. # Chi square test was used ($\chi^2=0.96$, df=1). Student t test was used to compare other variables.

While comparing the primary objective of the study i.e., the duration of postoperative analgesia, measured in terms of time for first rescue analgesic, no significant difference was observed between the two groups with a p value of 0.465 (Table 2). Both the groups were comparable in terms of quality of block measured by mean rescue analgesic requirement and patient satisfaction scores.

Table 2: Comparison study objectives.

Variable	Group T (n=20)	Group E (n=20)	P value
TFA (minutes)	448.75 (105.75)	461.5 (41.58)	0.465
Mean Tramadol consumption (mg)	230(80.13)	230(47.02)	1.000

Patient satisfaction scores ‡			0.524
3	0	1 (5%)	
4	11 (55%)	12 (60%)	
5	9 (45%)	7 (35%)	

TFA = Time for First Analgesic request. Group T= TLIP block, Group E= ESP block. Data were expressed as mean (standard deviation) or Proportion (percentage). ‡ Chi-square test was used ($\chi^2=1.293$, df=2)

Comparison of mean pain scores, measured periodically in the first 24 hours after the block, revealed comparable pain scores at all time intervals, except at P2 i.e. 2hours after surgery where pain scores were more in Group E compared to Group T (p= 0.029)

Table 3: Comparison of mean pain scores between the two groups

Time Interval	Group T		Group E		P value
	Mean	SD	Mean	SD	
P1	1.2	1.51	1.9	1.37	0.133
P2	1.5	1.43	2.4	1.05	0.029*
P4	2.3	1.98	2.9	1.77	0.319
P6	4.6	1.73	3.5	2.04	0.074
P12	5.7	2.08	5.2	2.19	0.464
P24	7.4	1.47	6.6	2.06	0.165

Table 3. Comparison of mean pain scores between the two groups in the post-operative period. (P1, P2, P4, P6, P12, P24 indicate pain scores measured at 1, 2,4,6,12 and 24 hours after surgery)

Tables 4 and 5 show comparison of hemodynamic variables between the two groups after the block has been performed. Heart rate and mean arterial pressure were recorded every 5 minutes after the block. Though the mean HR was comparable between the two groups, patients who received TLIP block had significantly higher HR compared to those who received ESP block until T4 i.e. upto 20 minutes after the block. MAPs were similar in both groups at all time intervals.

Table 4: Comparison of mean Heart rates between the two groups.

Time interval	Group T		Group E		P value
	Mean	SD	Mean	SD	
T0	86.5	8.8	82.4	13.56	0.264
T1	88.45	10.61	79.9	10.83	0.016*

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T2	86.2	10.7 6	77.2	12.0 9	0.017 *
T3	84.3	10.5 5	75.25	10.0 9	0.009 *
T4	83.15	12.3 1	74.3	10.5 1	0.019 *
T5	81.9	11.8 8	74.55	12.3 4	0.063
T6	81.8	12.9 9	74.15	11.3 7	0.055
T7	81	11.7 4	73.2	10.2 3	0.031 *
T8	80.7	12.3 2	73.67	9.16	0.056

T = TLIP, E= ESP, SD= standard deviation. P value <0.05 was considered statistically significant. Heart rate was recorded at every 5 minute intervals.

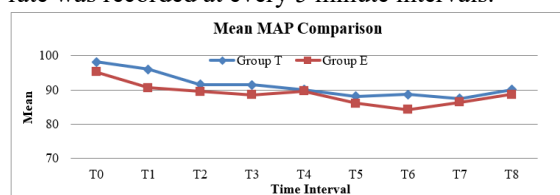


Figure 3: Line Diagram Showing Mean MAP Comparison between two groups

at different intervals of time. T= TLIP, E=ESP, MAP=Mean arterial pressure. P value > 0.05 at all time intervals.

DISCUSSION

TLIP block, a novel analgesic technique which was first described in 2015 by Hand WR et al, can contribute significantly to perioperative, multimodal, and opioid-sparing analgesic regimen and can enhance recovery after lumbar spine surgeries^[3]. TLIP block is a simple yet effective technique that targets the dorsal rami of the lumbar spine nerves as they pass through the paraspinal musculature. Mediolaterally multifidus, longissimus and iliocostlis are the three muscles in the paraspinal musculature. From medial to lateral, the multifidus, longissimus, and iliocostalis muscles are the three muscles in the paraspinal area. TLIP block is primarily aimed at injecting local anesthetic in the plane between the longissimus and multifidus muscles, spreading proximally to the point where the dorsal rami takes off from the spinal nerve root, thereby anesthetizing all the muscles of the lumbar area. TLIP block provides analgesia depending on the level of the injection site. In a study by Hand WR et al, it was found that the area of sensory block is 217±84.7 cm² at 20 min after injection at the level of T3. As the dorsal rami of the spinal nerves innervate the paraspinal muscles and posterior bony elements of the spine, the local anaesthetic may spread to the fascial plane between the multifidus and longissimus and exert its analgesic effect via the dorsal rami of the spinal nerves at multiple levels^[3]. In a randomised clinical trial done by Ammar et al., 102 patients were studied for the efficacy of TLIP block after administering general anaesthesia for

lumbar discectomy and concluded that there was significant reduction in postoperative pain scores. The mean surgical duration was 124.5±31.3 minutes and the time for first analgesic requirement was found to be 442.7±39 minutes^[5]. These results were similar to our study which showed the mean time for first analgesic request to be 448.75±105.75. Similarly, in a study done by Ueshima et al., lower pain scores were reported upto 24 h in patients who received general Anaesthesia with TLIP block as compared to patients who received GA only for lumbar laminoplasty. They also opined that the TLIP block may be safer and easier to perform than epidural anesthesia, paravertebral nerve block, and the retrolaminar block. This is because the TLIP block is administered more superficially^[6].

A retrospective study was conducted by Ueshima et al evaluating the efficacy of Erector spinae plane block for lumbar spine surgeries and concluded that pain scores and amount of opioid consumption was significantly lower in patients who received ESP block when compared to those who received GA alone.^[7]

A randomized control study was done by Singh et al on 40 adult patients undergoing posterior thoracolumbar spine decompressive surgeries and found that bilateral erector spinae plane block reduced the postoperative opioid requirement and improved patient satisfaction when compared to standard analgesia^[2]. US-guided ESP block has been reported to provide analgesia for somatic and visceral pain by effects on the ventral rami, dorsal rami, and rami communicantes of various spinal nerves. Clinical studies have shown excellent result with this block during surgeries involving thoracic and abdominal region^[8]. As the erector spinae muscle extends throughout the lumbar region, ESP block can also produce abdominal analgesia when performed at a lower level^[9]. Studies have shown that when 20 mL of contrast material was injected at L2, it has provided analgesia in lower back pain, and when performed at L4, adequate analgesia was obtained for proximal femur surgery^[10]. The analgesic effect of ESP block is due to its effect on dorsal and ventral rami of spinal nerves as well its spread in to the epidural and paravertebral spaces. But TLIP block targets only the dorsal rami of the spinal nerve roots and has focussed coverage over the back.

Lizhen Wang et al studied these two fascial plane blocks in lumbar spine surgery and found that the post-operative pain scores and opioid requirements were less in those patients who received ESP block than TLIP block^[11]. Our study revealed contrasting results as we found that the analgesic efficacy was similar with both fascial plane blocks. Similar results were found in another study where it was found that ESP and modified TLIP blocks provide adequate pain control after discectomy surgery and there is a non-superiority between the groups^[12].

Limitations

One of the drawbacks associated with our study was that we did not evaluate the pain scores in the preoperative period and compared them with pain scores 48 hours after the surgery to assess the quality of improvement in pain scores post the surgery. Also, quality of pain was not compared before and after the surgery to find out if fascial plane blocks have any impact on chronic pain after spine surgeries. Further studies with larger sample sizes are required to evaluate the effect of TLIP block on chronic pain after spinal surgeries.

CONCLUSION

Thoracolumbar interfascial plane block provides equally effective postoperative analgesic profile compared to erector spinae plane block for lumbar spine surgeries. Though the onset of action of TLIP block is slower compared to ESP block, the postoperative requirement of rescue analgesics is non-inferior to ESP block. Anaesthesiologists can choose either of the two blocks to provide effective intraoperative and postoperative analgesia in patients undergoing lumbar spine fusion surgeries under general anaesthesia.

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